

## CLAIMS

1. A beam control system comprising:  
first means for receiving a first beam of electromagnetic energy;  
second means for detecting aberrations in the first beam;  
third means responsive to the second means for generating a second beam that is  
5 at least partially compensated with respect to the aberrations; and  
fourth means for amplifying the second beam to provide an output beam.
2. The invention of Claim 1 wherein the electromagnetic energy is optical energy.
3. The invention of Claim 2 wherein the first means is a telescope.
4. The invention of Claim 3 wherein the first beam is a reflection from a target.
5. The invention of Claim 1 wherein the second means includes a wavefront error sensor.
6. The invention of Claim 5 wherein the third means includes a processor responsive to the wavefront error sensor for providing a correction signal.
7. The invention of Claim 6 wherein the third means further includes an optical phased array responsive to the correction signal.
8. The invention of Claim 7 wherein the third means includes means for illuminating the phased array with a reference beam.
9. The invention of Claim 8 wherein the third means includes a first conjugator

disposed in the optical path of the reference beam and the phased array.

10. The invention of Claim 9 wherein the third means further includes a second conjugator disposed in the optical path of the reference beam, the phased array and the first conjugator.

11. The invention of Claim 10 wherein the fourth means includes an amplifier disposed in the optical path of the second conjugator.

12. The invention of Claim 11 wherein the first and second conjugators are phase conjugate mirrors.

13. The invention of Claim 9 wherein the third means includes a Grating-Rhomb disposed in the optical path of the first beam and the second beam.

14. The invention of Claim 13 further including means for detecting aberrations in a wavefront of the output beam and providing a signal to the processor in response thereto.

15. The invention of Claim 14 further including an aperture sharing element disposed in the optical path of the first and the second beams.

16. The invention of Claim 15 further including means for detecting aberrations in the aperture sharing element and providing a signal to the processor in response thereto.

17. A beam control system adapted for use with a system for illuminating a target with a first beam of electromagnetic energy comprising:

first means for receiving a target return comprising a reflection of the first beam from the target;

- 5           second means for correcting for aberrations in the wavefront of the target return;  
          third means for ascertaining the correction applied by the second means to the  
target return; and  
          fourth means for applying the correction to a third beam, the third beam being  
an output beam.

18. The invention of Claim 17 wherein the fourth means includes a first phase conjugate mirror adapted to conjugate electromagnetic energy output by the third means.

19. The invention of Claim 18 wherein the fourth means further includes a second phase conjugate mirror adapted to conjugate the output of the first phase conjugate mirror.

20. The invention of Claim 19 wherein the fourth means further includes means for amplifying an electromagnetic signal output by the second phase conjugate mirror.

21. The invention of Claim 20 wherein the signal output by the means for amplifying is the output beam.

22. The invention of Claim 17 wherein the second means is an optical phased array.

23. The invention of Claim 22 further including an outcoupling element disposed between the first means and the second means.

24. The invention of Claim 23 wherein the third means is a master oscillator adapted to provide a reference beam.

25. The invention of Claim 24 wherein the reference beam illuminates the

optical phased array and provides a wavefront error correction detection signal in response thereto.

26. The invention of Claim 25 wherein the wavefront error correction detection signal illuminates a back surface of the outcoupling element and provides an outcoupling element back surface read signal in response thereto.

27. The invention of Claim 26 further including a first phase conjugate mirror for conjugating the outcoupling element back surface read signal.

28. The invention of Claim 27 wherein the conjugated outcoupling element back surface read signal is transmitted through the outcoupling element to a second phase conjugate mirror.

29. The invention of Claim 28 wherein the second phase conjugate mirror conjugates the conjugated outcoupling element back surface read signal and provides the outcoupling element back surface read signal in response thereto.

30. The invention of Claim 29 further including means for amplifying the outcoupling element back surface read signal.

31. The invention of Claim 30 wherein the amplified outcoupling element back surface read signal is reflected off of the outcoupling element to provide the output beam.

32. The invention of Claim 31 wherein the outcoupling element is an aperture sharing element.

33. The invention of Claim 22 further including a wavefront error sensor adapted to receive a signal output by the optical phased array and provide a wavefront

error signal in response thereto.

34. The invention of Claim 33 further including a processor responsive to the wavefront error signal for providing a correction signal to the optical phased array.

35. The invention of Claim 17 wherein the first beam of electromagnetic energy is optical energy.

36. The invention of Claim 17 wherein the first means includes a telescope.

37. A high-energy laser comprising:

a telescope;

an aperture sharing element disposed in optical alignment with the telescope;

an optical phased array disposed in optical alignment with the aperture sharing  
5 element;

a wavefront error sensor disposed in optical alignment with the optical phased array and adapted to provide a wavefront error signal in response thereto;

a processor adapted to provide a correction signal to the optical phased array in response to the wavefront error signal;

10 a source of a reference beam disposed in optical alignment with the optical phased array and the aperture sharing element;

a first phase conjugate mirror disposed in optical alignment with the reference beam;

15 a second phase conjugate mirror disposed in optical alignment with the first phase conjugate mirror; and

an optical amplifier disposed in optical alignment with the second phase conjugate mirror and the telescope.

38. A beam control method comprising the steps of:

illuminating a target with a first beam of electromagnetic energy;

- receiving a target return comprising a reflection of the first beam from the target;  
correcting for aberrations in the wavefront of the target return;  
5     ascertaining the correction applied by the second means to the target return; and  
applying the correction to a third beam, the third beam being an output beam.